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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

ANNUAL INVESTIGATIVE REPORT FOR 1928

and

PROGRAM FOR 1929

NORTHERN DISTRICT
and
NORTHERN ROCKY MOUNTAIN FOREST EXPERIMENT STATION
MISSOULA, MONTANA

GOVERNMENT PRINTING OFFICE

CONTENTS

	Page
PERSONNEL OF THE COMMITTEE	1
MATTERS OF GENERAL INVESTIGATIVE POLICY	1
Organization of the Annual Meeting	1
Types of Research Defined	2
Land Economics Studies	3
Resolutions by the Council	3
Idaho Forest Experiment Station	6
RESULTS OBTAINED BY THE NORTHERN ROCKY MOUNTAIN FOREST EXPERIMENT STATION	6
PROJECTS UNDER WAY AND PLANNED	9
Artificial Reforestation	9
Nursery Practice	9
Sowing and Planting	9
Seed Studies	10
Forest Influences	11
Forest Management	11
Methods of Cutting	11
Natural Reproduction	12
Brush Disposal	13
Thinning	13
Mensuration	14
Form	14
Volume, Growth and Yield	14
Protection	16
Diseases	
Blister Rust	16
Rot-Producing	17
Fire	17
Insects	21
Forest Products	22
Grazing	31
Ecology	33
Site Factors	33
Phenology	33
Forest Types & Succession	33
Species Studies	34
Silvics and Dendrology	34

CONTENTS (Cont'd)

Page

PROJECTS UNDER WAY AND PLANNED (Cont'd)

Economics 34
Practice of Private Forestry 36
Experimental Forests 38

RELATIVE URGENCY OF EXPERIMENT STATION PROJECTS 40

ARTICLES AND PUBLICATIONS 41

ALLOTMENT ESTIMATES 43

APPENDIX

Report of Committee on Organization and Functions of District Investigative Committee 44
Report of Subcommittee to Define Research 48

ANNUAL REPORT OF THE DISTRICT I INVESTIGATIVE COUNCIL FOR 1928

AND PROGRAM FOR 1929

PERSONNEL OF THE COUNCIL

The annual meeting of representatives of all agencies engaged in forest research in the northern Rocky Mountain region was held at the University of Montana Forestry School Library, in Missoula, January 10, 11, and 12, 1929. The following men were the delegated representatives of the Forest Service.

L. C. Stockdale, Chairman	Acting District Forester
R. H. Weidman, Secretary	Experiment Station
Elers Koch	Management
W.W. White	"
M. I. Bradner	Products
H. R. Flint	Operation
T. Lommasson	Grazing
H. T. Gisborne	Experiment Station
D. S. Olson	Planting
J. F. Brooks	Forest Supervisor

The representatives of other agencies included: Dean F. G. Miller, University of Idaho (Forestry School); Dean T. C. Spaulding, University of Montana (Forestry School); S. N. Wyckoff, in charge of the Spokane office of Blister Rust Control; J. C. Evenden, in charge of the Coeur d'Alene field station of the Bureau of Entomology; W. C. Chapin, of the Spokane office of the Weather Bureau; and Rutledge Parker, State Forester of Montana. Attending part or all of the sessions there were also present: Theo. Shoemaker, M. H. Wolff, I. T. Haig, and C. N. Whitney of the Forest Service, Professors Ramskill, Clark, and Cook of the University of Montana forestry faculty, and C. H. Johnson of Blister Rust Control. Invitations had been extended to the firm of Mason and Stevens, to the Western Forestry and Conservation Association, to State Forester Ben E. Bush of Idaho, and to Director T. T. Munger, but these men were unable to attend. Both the average and the total attendance at this year's meeting were less than in 1928.

MATTERS OF GENERAL INVESTIGATIVE POLICY

Organization of the Annual Meeting

The subcommittee appointed in 1928 to examine the organization and functions of the annual investigative meeting submitted its recommendations, which will be found in the appendix to this report. The principal conclusions of this subcommittee were: that the main purposes of the annual meeting are informative and co-ordinating; that the name should be changed from Investigative Committee to Investigative Council; that the growth of forest research in this region has greatly expanded in the last ten years; that the voting membership of this

meeting should be extended to include representatives of the new agencies outside the Forest Service; that each agency should have its own research-control committee to which the recommendations of the Council should be addressed; and that the presentation of reports to this Council should be by major lines of work following a complete outline of all major phases of forest research so that the absence of work on any phase shall be brought clearly to the attention of the Council each year.

The proposed plan of operation for the Council was adopted and followed by the meeting. Although the results were not perfectly satisfactory, the new method appreciably aided the co-ordinated presentation of material and assisted in shortening the time required for covering 103 existing and proposed projects submitted for consideration by the six agencies represented. Recommendations were made for certain specific changes in the preparation of status sheets which should further expedite the work at future meetings. Apparently it will be necessary in the future to restrict the discussion of individual projects if the Council is to give more consideration to the need for and distribution of research by major lines of work, without increasing the number of days required for this annual meeting.

Types of Research Defined

For several years there has been increasing conviction in this region that some of the projects submitted to the Investigative Council for consideration are not truly research in character and need not come before this body for discussion. The disparity between projects has become more pronounced as more agencies have submitted statements of their work. This situation calls for a definition of research and related terms. Such definitions are also essential if accurate estimates are to be obtained of the expenditures by lines of research work. To help clear up the difficulties, a special committee was appointed in 1927 to report at the 1928 meeting of the Council. The full report of this committee will be found in the appendix.

The Council's discussion of this report brought out many differences of opinion, helped to clarify the general understanding of many terms and words, and resulted in a few modifications of the original report, which are included in the appended copy. There was not complete agreement upon the value of and the need for annual statements of research costs or expenditures. Although such statements are easily prepared by some agencies, whose entire funds are allotted for research work, others, such as the Forest Schools, can only estimate their expenditures because much of the time spent on research is contributed by the faculty and by students assigned to special projects. The consensus of opinion, however, was in favor of collecting cost statements each year to serve as an index of the efforts actually being devoted to the various problems in the region. It was felt that it will be possible in this way better to determine whether or not certain lines of research are neglected largely because of lack of available funds. It was realized by the Council that there

is no opportunity of transferring funds between agencies. There are, however, distinct possibilities of allocating needed work, which can not be financed by one agency, to another which may have available funds or personnel. There are also opportunities of changing the emphasis on lines of work within any agency so that the most urgent and promising projects may receive their deserved share of finances and effort.

Although the definitions of types of scientific inquiry offered by the Committee, such as those for research, investigation, study, and experiment, seem to be desirable for uniformity of language among research workers, it is believed that little is to be gained by extremely fine distinctions in the characterization of projects. There was also a call for defining just what constitutes a project. Both of these matters were left in abeyance pending further study by the subcommittee composed of Weidman, Wyckoff, Spaulding, and Hubert. This committee was instructed, however, "to determine the character of projects or lines of work, which should be presented to the Investigative Council each year, and which should be incorporated in the annual report. And to report to the chairman of the Investigative Council before November 1, 1929," so that all agencies may be fully informed when the call is issued for the next meeting. It was also agreed that each status sheet submitted for future consideration should be designated by the author to classify it as research, investigation, experiment, or study, according to the definitions prepared by the subcommittee. The casual references to this classification, as the projects were discussed this year, indicated that there is only a small proportion of fundamental research in progress in this region compared to the volume of investigation, experiment, and study.

Land Economics Studies

M. H. Wolff, Chief of the Office of Lands in District One, called to the attention of the Council the lack of attention in the past to the subject of land economics. This subject is of fundamental importance in forestry, yet until this year's meeting no projects in this field have been reported and recognized. The Council agreed that the appreciable amount of effort now being devoted to this subject should be encouraged and recognized, if projected.

Resolutions by the Council

Toward the close of the meeting, after a thorough discussion of nearly all the projects included by each major line of investigation, the Council adopted the following seven resolutions:

I

Whereas, the successful control of forest fires depends to a large extent on adequate research into the various phases of the fire problem; and

Whereas, the relatively small effort now being devoted to such research by the Northern Rocky Mountain Forest Experiment Station, amounting to but two-thirds of the time of one man, is entirely inadequate to the needs of the region; therefore

Be it resolved that a substantial increase in funds is needed for fire research and should be made available to the Experiment Station for the next ensuing fiscal year.

II

Whereas, the solution of the forest-fire problem in Montana and northern Idaho depends to a large extent on fire-weather studies conducted by the Spokane Office of the Weather Bureau, whose present annual allotment of approximately $1,500 is altogether inadequate to cover the needs of a region which is generally recognized as the worst in the country from the standpoint of forest-fire conditions; and

Whereas, it is the opinion of the members of the District research council that the proper prosecution of these studies requires an annual allotment of $8,000; therefore

Be it resolved that measures be taken through the proper authorities to increase to the amount indicated the funds allotted to the Spokane Office of the Weather Bureau for this purpose.

III

Whereas, the present allotment of the Northern Rocky Mountain Forest Experiment Station is inadequate to carry out its existing program and is only half enough to take care of the research in fire, planting, silviculture, and other subjects which this and past District research councils have considered urgently necessary to undertake; and

Whereas, there is need in the larch-fir type for studies of growth, reproduction, and methods of cutting; in the lodgepole-pine type for guidance in methods of thinning and cutting; in the white-pine type for a yield-application study, and for additional permanent sample plots in methods of cutting to cover more adequately the various conditions in the type; and

Whereas, the Council understands that the McSweeney-McNary Act provides for the gradual increase in funds for the forest experiment stations of the country over a 10-year period; therefore

Be it resolved that this Council strongly urges that the Northern Rocky Mountain Forest Experiment Station be placed in line for an increase in its allotment under the McSweeney-McNary Act of at least $25,000, to become effective during the fiscal year 1931.

IV

Whereas, the successful management of the National Forest ranges in District One is dependent upon a thorough knowledge of the facts underlying the growth and use of their forage plants; and

Whereas, there is very urgent need for such information and no research funds available for conducting range investigations; therefore

Be it resolved that this Council declare itself in favor of a sufficient allotment of funds under the McSweeney-McNary Act to start the work on an adequate scale beginning with the fiscal year 1931.

V

Whereas, the need of range research for the perpetuation and management of lands in the Great Plains region and the mountain valleys of the Northern Rocky Mountains, largely outside of the National Forests, is recognized by this Council and the stockmen of these regions; and

Whereas the Bureau of Animal Industry has the plant and the livestock necessary for such range research at the U. S. Livestock Experiment Station at Miles City, Montana, but lacks funds and personnel; and

Whereas, the Forest Service has a personnel trained in such work; therefore

The Council urges that action be taken toward securing funds necessary to enable these two agencies to co-operate in carrying on the desired work.

VI

Whereas, the forest-insect depredations which occur in this region seriously deplete its resources of standing timber and menace the practice of forestry; and

Whereas, the funds and personnel of the Coeur d'Alene Station of the Bureau of Entomology are insufficient to conduct adequately the needed forest-insect investigations leading to efficient means of prevention and control and are also inadequate to extend a liberal educational and co-operative service to the forest-managing agencies of the region; therefore

Be it resolved that increased funds be made available to the Bureau of Entomology for the purpose of enabling its Coeur d'Alene Field Station to meet adequately the needs of the region.

Whereas, the recent spread of white-pine blister rust in northern Idaho brings immediate danger to the white pine stands of this region; and

Whereas, the experimental and the investigative program now being conducted by the Bureau of Plant Industry has resulted in developing control methods which must now be put into effect to prevent rapid damage by this disease; and

Whereas, continuance of this program will result in further improvement of these methods and the development of new ones; therefore

Be it resolved that this Council favors the continuation of the experimental program for such time as may be necessary to exhaust every possibility of increasing the effectiveness and lowering the cost of blister rust control.

Idaho Forest Experiment Station

The past year marked the entrance of a new agency into the field of forest research in this region. Although the School of Forestry of the University of Idaho has always been very active in this field, the formal organization of the Idaho Forest Experiment Station, with Dean Miller as Director, is certain to result in more rapid progress on our many troublesome problems. Due to the variety of research work needed on Federal, State, and private lands, and because the new Idaho station intends to confine its work largely to State and private areas, there will be no overlapping of investigations by different agencies. All foresters and lumbermen will a appreciate the farsightedness of the State of Idaho, the University authorities, and the lumbermen who are supporting this movement.

RESULTS OBTAINED BY THE NORTHERN ROCKY MTN. FOREST EXPERIMENT STATION

Although the technical staff of the Northern Rocky Mountain Station has been reduced to three men, by Marshall's and Kempff's departures during the past year, the practicable results obtained from the various projects under way have been nearly equal to those of previous years.

In the management studies, field work has been completed in a very extensive and detailed examination of cut-over areas to determine what has happened on Forest Service timber sales logged within the past five to twenty years. As shown by the status sheet for the methods-of-cutting project, the conclusions which will be obtained from the office analysis now under way will be based on a very substantial and well-distributed mass of data. The report based on this field work is urgently needed by Forest officers in order that they may know dependably what conditions have resulted from past methods of cutting and how to modify future methods so that better silviculture may be practiced in the western white pine type. This information will be

of value also to State and private foresters in guiding their work. It is hoped to have a preliminary report on this phase of the methods-of-cutting study ready for distribution within a few months.

A small, but intensive methods-of-cutting study was also completed during the past field season to assist in solving an important problem in the silviculture of the western white pine type. In order to determine how best to handle the hemlock understory in white pine stands, and to learn the effect on pine reproduction of different methods of treating the understory, a special study was made on the Coeur d'Alene Forest in the immediate vicinity of a large timber sale where these conditions are especially important. The results of this investigation were immediately applied in administrative policy in this case.

Another significant contribution of the past year was the distribution to 167 agencies and individuals, of the normal-yield tables for western white pine. This project has required a larger part of the funds and time of this Experiment Station for several years. The resultant tables state the normal yields of western white pine to be expected at any age up to 160 years, for eight classes of site, in terms of cubic feet and board feet by both the Scribner and International 1/8-inch rules. Such information is highly essential in determining the practicability and possible profits of forestry.

Work was also completed on an illustrated leaflet designed to demonstrate the value of holding second-growth timber for growth and later market in northern Idaho and western Montana. There is a marked need for more educational information on such possibilities in this region and 10,000 copies of this leaflet have been published in attractive style under the title "Second Growth Timber Worth Holding in Northern Rocky Mountains." The data used consisted of short yield tables for western white and yellow pine, as determined by Haig and Behre in their research work. The leaflet has received an excellent reception throughout the region.

The principal contribution from fire studies during the past year consisted of the publication of Miscellaneous Circular No. 29, "Measuring Forest Fire Danger in Northern Idaho." This report summarizes the results of four years of investigation of the factors that control forest-fire danger in this region. It points out which factors are the most important, how they may be measured rather than estimated, and how such measurements can be used in improving the protection of forests from fire. About 4,800 copies of this report were printed.

A secondary contribution to improved protection consisted of an article showing the effects of different degrees of overwood on the period and degree of inflammability of the duff and similar ground fuels. No measurements had been available in the past to show whether or not the canopy of the residual stand had any effect on the moisture content and inflammability of the fuels on the ground. A summary of

some of the fire-study measurements for the past three years brought out the fact that such a canopy should be retained even at some expense because of its beneficial effects on subsequent fire danger. This article was published in the Timberman under the title "Brush Disposal."

Work was completed during the year by Wahlenberg on three artificial reforestation projects, which needed merely the final revision of manuscript reports preparatory to publication. One of these, "Experiments with Classes of Stock Suitable for Forest Planting in the Northern Rocky Mountains," covers the essential results of all the experiments in age and size classes of western white and yellow pine stock conducted in this region, beginning with the first experimental plantations in 1911. About 2,300 copies of this report have been requested to supply all interested parties. Another revised report now awaiting publication is that describing "Investigations in Chemical Weed Control at Savenac Nursery." This subject has proven to be of nearly world-wide interest to forest nurserymen, many of whom have kept in constant touch with this research as it progressed. A third report, "Modifications of Western Yellow Pine Root Systems by Fertilization in the Nursery," was also sent to press during the past year. This phase of forest-nursery work has been very troublesome in the past, and the present contribution from research is certain to prove of practical value in many parts of this country. Each of these three studies was commenced in order to solve certain nursery and planting problems which were particularly troublesome in the northern Rocky Mountain region. The results have served in each case to improve the efficiency and to reduce the costs of successful reforestation very materially.

The important effects of source of tree seed on the survival and growth in another region under different climatological and soil conditions is being recognized more and more clearly as a fundamental problem in forestry. During the past year the Northern Rocky Mountain Station published a brief progress report on an experiment commenced twelve to fifteen years ago to determine the survival and growth of western yellow pine in northern Idaho from seed collected throughout the entire natural range of this species in the United States. This report, entitled, "Nonindigenous Western Yellow Pine Plantations in Northern Idaho," states the results to date and indicates also the causes of some of the outstanding variations.

Very little is known, yet there is widespread local curiosity concerning the origins and life histories of western white pine stands in northern Idaho. To obtain more specific information on these conditions, Marshall made a careful study of species occurrence, growth, and age on four common white pine sites, and published the results under the title, "The Life History of Some Western White Pine Stands on the Kaniksu National Forest."

PROJECTS UNDER WAY AND PLANNED

Artificial Reforestation

Nursery Practice

The completion of two reports by Wahlenberg on investigations of certain phases of nursery practice has been previously mentioned. Olson's manuscript report covering all phases of nursery practice in this region also received a final revision and is now in Washington awaiting publication. He is now engaged in the preparation of a manuscript entitled, "Forest Planting in the Northern Rocky Mountain Region."

The Forest Service does not list any active research projects in nursery practice, but the routine work at Savenac Nursery includes a continual check of the results of previous research as well as considerable systematic effort to improve present practices. Included by such efforts are: the hardening off and the root-control studies; the eradication of thistle and quack grass by use of chemicals; the identification of common nursery weeds and the formation of an herbarium; the presence of weed seeds in the irrigation water and the possibility of removal by filtration; the determination of soil and water temperatures and their effects on stem girdling; the isolation and identification of each type of loss, between seed and final product in the nursery, and the determination of the economic feasibility of reducing each of these losses by further refinements in nursery practice; continued experimentation with different fertilizers and methods of cultivation; and the production of hardwoods, exotics, and native stock for ornamental use at ranger stations.

Both the Universities of Idaho and Montana maintain forest nurseries, partly or wholly financed under the Clarke-McNary Law, and both are making continual tests of the results of previous research and attempting to improve their practices in every way possible. At neither of these nurseries, as at Savenac, is there any research or investigation under way designed purely for the purpose of extending general knowledge of nursery practice, which should be designated as a research project. At all three nurseries it is planned, however, to publish all outstanding discoveries.

Sowing and Planting

The Forest Service initiated during the past year a purposeful study and experiment to determine suitable species and best methods of planting on creek-bottom lands where vegetation, particularly grass, is luxuriant. This is a minor project which as yet includes only two plots, and which is expected to be completed by the fall of 1930. Considerable routine work is also under way, such as an annual check by staked rows of spring versus fall planting on all the areas planted in this region by the Forest Service each year; the installation and periodic inspection of permanent-growth plots in plantations to

determine effect of density on later growth -- some pruning is also being done on one of these plots; and during 1928 a survey was practically completed of all Forest Service plantations in this region more than 10 years old. This survey borders closely on research in that it was very extensive and detailed, covering about 24,000 acres with data from 51,000 mil-acre plots, and in that the results will add very appreciably to the general knowledge of forest planting in this region. The data obtained include survival, height growth, types of damage, suitability of species by mixture and by sites, and the presence and effects of natural reproduction. The results show, among other things, the existence to-day of an average of 345 trees per acre, both planted and natural stock, of which 79 per cent are planted stock.

The University of Idaho is continuing the three planting projects described in last year's report. The study of windbreaks has yielded definite and practicable information and it is expected that this work, which has been financed under the Purnell Act, may be discontinued this year. In the study of forest and shade-tree planting on alkali soils, plantations of twenty species were made during the year on alkali and alkali-free plots. Periodic examinations of these plantations, soil analysis, and replacements of trees will be continued for an indefinite period. Plantations also were made in the study of forest and shade trees at higher elevations in Idaho.

At the University of Montana forest nursery several species of native and exotic trees are being grown for distribution under the Clarke-McNary Law. The species selected include the 5 or 6 conifers and the 8 or 9 hardwoods that are commonly adaptable to the semiarid conditions of the northern Great Plains region. For several years, much of this work is to be considered as experimental. Distribution of this stock and records of success or failure are handled by the Extension Forester of the College of Agriculture at Bozeman.

Seed Studies

There have been no new developments during the past year in the western yellow pine source-of-seed experimental plantations which were established in 1911. The report on the examination made in 1927 has been given wide circulation and is still in occasional demand.

During the year, Olson initiated a project designed to determine the comparative value of seed from various age classes in western white pine, as measured by bulk yield per cone, bushel, and tree, and by germinative energy. Unfortunately, the cone crop in 1928 was light and scattered, consequently, very little progress was made. This is a minor project, in time and money expended, but it is devoted to a most important field in which there is very little information available to-day.

The University of Montana expects this year to complete its first series of tests of methods of stimulating the germination of 37

METHODS OF CUTTING -- PERMANENT SAMPLE PLOTS
Northern Rocky Mountain Forest Experiment Station
All plots in western white pine type

Year Established	Plot No.	Interval of Exam's. Tree Measurement	Interval of Exam's. Reprod. & Cone Crop	Date of next tree Measurement	Area of Plot Acres	No. of Reprod. Quadrats	Method	Purpose
1914	1	5 yrs.	5 yrs.	1929	1	100	Selection -left 1/3 of stand	2nd cut & reprod.
1926	119	"	annual	1931	1	13	Cut overwood - left understory	2nd cut from understory
"	120	"	"	"	2	27	Hemlock disposal 3 W. P. seed trees per A.	White pine reproduction
"	121	"	"	"	10	100	Seed trees 8 W. P. per acre	" " "
1927	136	"	"	1932	3	36	Seed trees 3 W. P. per acre	" " "
"	139	"	"	"	1.5	25	Clean cut both overwood & understory	" " " seeding from side
"	140	"	"	"	1	25	Cut overwood and left understory	2nd cut from understory
1928	137	"	"	"	1	25	Residual stand, 2 W.P. seed trees per A.	2nd cut and reproduction
"	138	"	"	"	1	25	Residual stand, 5 W.P. seed trees per A.	" " " "
"	141	"	"	"	1	7	Left improved understory	" " " "
"	142	"	"	"	1	-	Left suppressed hemlock understory	2nd cut only
"	144	"	"	1933	2	80	Hemlock disposal 8 W. P. seed trees per A.	White pine reproduction and 2nd cut

All these plots are on the Kaniksu, except #1, which is on the Coeur d'Alene.

species of native and exotic shrubs, vines, and trees. This work has been under way for three years and includes the use of various chemicals and bird manures in an effort to duplicate the known and supposedly beneficial action of bird digestion on seed germination.

A test of viability of seed stored in air-tight bottles for periods of 8 to 17 years was made for eight tree species by the Experiment Station during the year, but due to the press of other office work the results have not yet been compiled.

Forest Influences

There are no investigative projects in progress in this region at present dealing with this important phase of forestry. In connection with other studies, some observations are being made of erosion on one of the methods-of-reproduction permanent plots, and the measurements of fuel-moisture contents and temperatures on three different exposures covered by the fire studies may be expected to be of value in studying forest influences later on. The collection of year-round weather records at two Forest Service stations, part-time records at 10 or 15 other stations, and snow-depth readings at about 90 stakes, also should be of future value.

Forest Management

Methods of Cutting

The Northern Rocky Mountain Forest Experiment Station project constitutes the only active investigation of methods of cutting in the white pine type in this region. The University of Idaho work mentioned last year is dormant, and the administrative examinations of Forest Service timber sales are largely in the nature of inventories.

The Experiment Station project employs both the survey and the permanent-plot methods of obtaining data. Strip surveys have now been made on 32 cut-over areas, including 19 selection cuttings, 11 clear cuttings with 3 different types of seed-tree distribution, and 2 shelterwood cuttings. The data are in process of compilation and a preliminary report on this phase of the work should be available early in 1929. Unless the compilation shows a clear need for it, no further work is contemplated in the near future for this phase of this project.

Permanent sample plots with all residual trees tagged for periodic identification and remeasurement, and including sufficient permanent reproduction quadrats to give a dependable measure of the growth of the second crop, constitute an essential process in the study of methods of cutting timber. For this purpose twelve plots, varying in size from one to ten acres, have been established, largely during 1926, 1927, and 1928. The following table lists the main features of each of these plots.

These 12 methods-of-cutting plots contain 2337 tagged trees and 463 reproduction quadrats. These quadrats are chiefly mil-acre in size and the seedlings are staked. The next tree measurements will be in the fall of the year shown in the table. Reproduction and cone crops will be examined annually in the fall for the next 10 to 15 years.

As shown by this table, eleven of the twelve present plots are on the Kaniksu National Forest in the northern commercial range of western white pine. A similar series of plots should be established on the Coeur d'Alene Forest, and later on the Clearwater, to obtain more accurate data on the results of different methods of cutting in these different climatological and geological regions which represent the central and southern limits of commercial stands of this species. Such extension must of necessity be very slow, however, until financial support for such work is greatly increased.

Natural Reproduction

The Northern Rocky Mountain Forest Experiment Station continues as the only agency in this region studying reproduction after forest fires and after logging, in order to determine the fundamental conditions which control germination and survival of our native tree species. Although the principal effort is centered on western white pine, a large amount of information is also being obtained concerning all of the associated species. The work employs various methods of research in the study of seedproduction, dissemination, storage, germination, and seedling establishment.

The effort devoted to seed production initiates a practical method of attack by the use of a large number of seed traps in stands of various ages, from 75 to 300 years, on different sites, some cut over, some burned, and some in a virgin state. These traps serve to study seed dissemination under natural conditions. Specific information on seed-dispersal distances according to seed species, height of release above ground, and wind velocity have been obtained by kite and balloon experiments made for us by the Pacific Northwest Forest Experiment Station. Experiments have also been started at Priest River in killing trees by fire at different stages of the growing season to determine the effect on later ripening of cones. A new and elaborate series of experiments in storage of seed in the duff, lasting eight years, has been started to obtain more information on this phase of the problem. The annual examinations of 1053 screened and unscreened reproduction quadrats give results on disseminated and naturally stored seed, and also on germination and survival by seedbed surfaces, such as mineral soil, duff, charcoal, rotten wood, etc.

In this study of natural reproduction, which employs the methods of true research as well as investigation and experiment, eleven permanent reproduction plots have been established, as described in the following table. All of the methods-of-cutting plots which contain reproduction quadrats also serve in this study. The result is a very

NATURAL REPRODUCTION - PERMANENT SAMPLE PLOTS
Northern Rocky Mountain Forest Experiment Station
All plots in western white pine type

Year Established	Plot No.	Interval of Examinations: Tree Measurements	Reprod. Counts	Cone Crop	Area of Plot: Acres	No. of Quadrats: Screened	Unscreened	Condition being Studied	Purpose
1919	-	-	-	-	7	None	14	-	-
1923	-	None	-	-	1.35	"	6	Burn	-
1926	124	"	Annual	Annual	Line of Quads	"	50	Burn - 70 yr. stand N. slope - scat. seed trees	Rate & character of restocking
"	125	"	"	"	"	"	10	Same burn - S. slope no seed trees	"
1927	129	5 years 1932	Semi-annual	"	6	36	36	Med. burn-mat.stand many seed trees	Seed trees vs. stored seed. Also fire damage
"	130	"	Annual	"	Line of Quads	33	33	Hard burn-logged area, seeding from side	Distance of seeding and stored seed
"	131	"	Semi-annual	"	"	28	36	Hard 2nd burn seeding from side	"
"	132	"	Annual	"	7	50	50	Hard burn 2-aged stand. Sc. seed trees	Seed trees vs. stored seed. Fire damage
"	133	"	Semi-annual	"	8	64	64	Hard burn-mat.stand many seed trees	"
"	134	"	"	"	5	18	42	Logged-pile & burn few seed trees	Seed trees vs. stored seed
"	135	"	Annual	"	3.9	20	20	Logged-pile & burn many seed trees	"

All these plots are on the Kaniksu Forest except the one established in 1923, which is on the Coeur d'Alene.

THINNING -- PERMANENT SAMPLE PLOTS

Northern Rocky Mountain Forest Experiment Station

All plots in western white pine type

Year Established	Plot No.	Interval of Exam's.	Date of next tree Measurement	Area of Plot Acres	Character of Thinning
1914	101	5 yrs.	1929	0.5	Check
"	102	"	"	"	Light from below
"	103	"	"	"	Medium " "
"	104	"	"	"	Medium heavy from below
1919-20	105	"	"	"	Check
"	106	"	"	"	Light from below
"	107	"	"	"	Medium " "
"	108	"	"	"	Heavy " "
1925	109	"	"	0.375	Very heavy from below
1926	110	"	1930	0.2	Heavy from below
1925-26	111	"	"	1.0	Borggreve

All of these plots are on the Priest River Experimental Forest.

extensive distribution of conditions studied, which should begin to produce usable information within the next few years. Plans for the immediate future contemplate merely the annual field examinations of the present experiments, which require the time of one staff member and two temporary assistants for 5 months each year. No extension of these studies is planned under present conditions of funds and personnel.

Of this total of 11 large reproduction plots, two, established in 1919 and 1923, are of doubtful value and may have to be dropped. The 9 effective plots contain 1379 tagged trees and 590 reproduction quadrats. The quads are chiefly mil-acre in size, excepting those that are screened, which are 1/4 mil-acre. There are 80 permanent seed traps on 6 of these 11 plots; these are examined at 15-day intervals during the season. The purposes of all plots are to determine by parallel screened and unscreened quadrats to what extent reproduction comes from stored seed and scattered seed trees following logging and fires; also distance of effective seeding; the success of restocking on duff, ashes, mineral soil, etc.; fire injury and mortality of seed trees. The semiannual reproduction examinations are made in June and October; the plots receiving only one reproduction examination a year are examined in August and September.

Brush Disposal

The Idaho Forest Experiment Station this year commenced an investigation of adequate slash-disposal practices in northern Idaho. The work is planned to include the benefits, methods, and costs of eliminating logging debris, largely on private lands. Preliminary work has been devoted to a survey of the field and to better methods of piling and igniting slash so that burning can be done during longer periods in the spring and fall. The plans for this study include partial as well as complete disposal practices. One of the outstanding impediments to more universal practice of piling and burning is the shortness of the period when burning can be done with safety. Improvements already made in an ignition torch have resulted in quicker ignition of all piles, and the possibility of getting ignition in some piles which were too wet to burn by ordinary methods. Field tests with the improved torch have given very promising results.

Thinning

Only two thinning projects are under way in this region. One, in western yellow pine, consists of 6 plots on the Custer Forest, where the operations are financially self-supporting, and where the information is greatly needed because of the extensive thinning that can be done profitably in that region. A progress report covering these experiments was submitted in March, 1928, and the work is to be continued in accordance with the working plan. No extension is possible, however, because of lack of funds. The present work is done entirely by administrative effort, with occasional counsel from the Northern Rocky Mountain Station.

The second experiment in thinning comprises 11 permanent sample plots containing 4,966 tagged trees and located in 60 to 70-year-old western white pine stands on the Priest River Experimental Forest. A progress report should have been completed in 1928 covering past measurements of these plots, but due to Kempff's change of work, this must be prepared in 1929. The following table includes the essential information concerning each of these plots. No extension of this work is possible at present, although need for it has been expressed by the Office of Management, in the case of plots in younger white pine stands, and by several National Forests in the case of lodgepole pine where guidance is needed in existing problems.

Mensuration

Form

The University of Montana has one project devoted to the use of the form quotient in cruising timber. A simple rule has been evolved which, when checked on 833 western yellow pine trees, gave a maximum deviation of 11 per cent and an average of only 0.6 per cent. Similar work is now under way on Douglas fir and larch.

The University of Idaho has three projects which, while primarily devoted to growth and yield of residual stands of western white pine, yellow pine, and cedar, also include studies of change in form after release by logging. Progress reports on each of these projects are to be expected within the next year or two.

Volume, Growth, and Yield

The three projects conducted by the Idaho Forest Experiment Station, just mentioned, employ temporary plots in the yellow pine and cedar types, and ten permanent one-acre plots in white pine, all on privately owned cuttings. The information to be obtained is urgently needed both by the owners and by consulting foresters who desire to know more accurately what growth may be expected from residual stands as a contribution toward a second cut. Such data are, of course, basic to complete management plans.

Such information is also needed by the Forest Service, and the District Office of Management has two projects devoted to this subject, while the Northern Rocky Mountain Station has contributed its services in the study of cut-over areas, previously mentioned, which included acceleration of growth in residual stands as a part of the methods-of-cutting study. The District projects are devoted to growth and yield after cutting in lodgepole and in western yellow pine, the latter study complementing the work of the Idaho Station by covering Federal lands cut over according to Forest Service silvicultural practices. This work has already shown that western yellow pine stands in northern Idaho have responded to cutting very differently from similar stands in western Montana.

GROWTH AND YIELD -- PERMANENT SAMPLE PLOTS

Northern Rocky Mountain Forest Experiment Station

Year Established	Plot No.	Exam's. every 5 yrs. Date of next	Area of Plot Acres	Forest Type	Age when Estab.	Condition
1916	122	1931	0.25	Larch	60	Normal Stocking, Site II
"	123	"	0.20	D. Fir	60	80% of Normal, Site III
1922	1	1932	2	W.W.P.	95	Normal Stocking
"	2	"	2	"	56	"
"	3	"	2	"	34	"
"	4	"	2	"	48	"
"	5	"	2	"	80	"
"	6	"	2	"	80	"
"	7	"	2	"	32	"
1923	8	"	2	"	34	"
"	9	1929 May	2	"	75	"
"	10	"	1	"	75	"
"	11	"	2	"	75	"
"	12	"	1	"	30	60% of Normal (approx.)
"	13	"	1	"	30	Normal Stocking
"	14	"	2	"	55	"
"	15	"	2	"	55	"
"	16	"	1	"	55	"
"	17	"	1	"	55	"
1925	112	1930	0.5	"	36	60% of Normal, Site I
"	113	"	0.5	"	36	20% of Normal, Site II
"	114	"	0.1	Cedar	70	Normal Stocking, Site I
1926	115	"	0.125	D. Fir	70	Normal Stocking, Site I
"	116	"	0.125	"	70	Normal Stocking, Site I
"	117	"	0.125	W.W.P.	70	Normal Stocking, Site I
"	118	"	0.1	"	70	Normal Stocking, Site I
"	126	1931	0.1	"	40	80% of Normal, Site I
"	127	"	0.1	"	40	80% of Normal, Site I
1927	143	1932	0.05	"	29	Normal Stocking, Site I

Plots #1 to 17, inclusive, are on the Coeur d'Alene Forest, the remainder are on the Kaniksu.

MISCELLANEOUS PERMANENT SAMPLE PLOTS

Northern Rocky Mountain Forest Experiment Station

Year Established	Plot No.	Project	Interval of Exams.	Date of next Exam.	Area of Plot Acres	No. of Sub Plots	Forest Type	Purpose
1911-16	-	Planting	5 yrs.	1932	2 Approx.	22	W.Y.P.	To compare adaptability of 19 climatic varieties from Canada to Mexico
1925	-	Weeding	"	1930	1/40	-	W.W.P.	Liberate W.P., C., E.S. from dense H., W.F. etc., in 25-year-old reprod.
1926	127	Pruning	"	1931	0.1	-	"	Butt logs pruned to secure better quality
"	-	Seed Production	15 days	-	-	80 seed traps	"	To ascertain amount, dissemination & frequency of
1927	-	Seed Storage	Annual	1929	-	8	"	Seed of 8 species stored in duff to be recovered and germinated each year for 8 years to ascertain viability
1928	-	Fire Damage	"	"	0.1	-	LP-DF	To determine rate of spread and other factors of fire behavior and after effects

All these plots are on or near the Kaniksu Forest, except the one established in 1925, which is on the Coeur d'Alene.

The principal effort of the Northern Rocky Mountain Station, devoted to growth and yield, has been confined in the past to the production of normal-yield tables for the white pine type. This information, together with second-growth volume tables for six species, was completed, mimeographed, and given a wide distribution during the past year. The preparation of a final report on this work, and the possible need for a study of methods of applying these tables, remain as jobs for the future.

There are also 29 permanent yield plots containing 25,675 tagged trees, which are described in more detail in the following table, that have been established and must be remeasured periodically for many years, in order to obtain more accurate data covering the actual growth of specific stands. Of these 29 plots, 24 represent western white pine and are rather evenly divided between the Kaniksu and Coeur d'Alene Forests, thereby including both the northern and central commercial ranges of the white pine type, and thereby insuring against too great a loss in case of fire. It is probable that, when funds permit, a similar series of plots should be installed on the Clearwater Forest in the southern range of this type.

The other five plots include one in larch, one in cedar, and three in Douglas fir. At the Council meeting the need was stressed for more information concerning the growth and yield of fir and larch, which cover such a large proportion of the area in this District. Such information is needed not only concerning virgin growth, but also for the residual stands on cut-over areas, of which there is a great and increasing acreage in this region. Some information is being collected on this subject by the District study of yellow pine cut-over areas, because this work includes the associated species as well as the yellow pine. The present effort is not deemed sufficient, however.

Except for some student class work by the University of Montana School of Forestry, there is no work under way in western Montana dealing with the growth and yield of western yellow pine second-growth and virgin stands. Behre's yield tables for yellow pine in Idaho have not yet been checked in western Montana, but they should be before an extensive effort is devoted to the construction of new tables. Some of the results of studies of yellow pine cut-over areas also can be used in checking Behre's tables, or in preparing new ones.

The District Office project devoted to the growth of young cedar to pole sizes has been dormant for several years, and there is no opportunity apparent for continuing it. As the Idaho Station has an active project dealing with the growth of residual cedar, the Council recommended that the Forest Service data be made available to Professor Nettleton.

In addition to the various permanent sample plots, described in preceding tables, the Northern Rocky Mountain Station has 6 others established for special purposes as follows:

Protection

Diseases (Blister Rust)

The discovery during the past year of blister rust on western white pine about 25 miles northeast of Spokane, and the infection of Ribes plants in various localities throughout the Idaho white pine region, have changed the problem of blister rust control from the future to the present. This actual arrival of the dreaded disease had been expected, however, and the present discoveries have caused little, if any, change in the research work devoted to methods of control. Mr. Wyckoff, in charge of all blister rust control work in this region, has outlined the research effort of his office as follows:

"I. Line of Investigation. Development of methods of blister rust control suitable to forest conditions existing in the white pine type of District One. Projects under way or contemplated are:

1. Development of actual control working methods.

    a. By means of hand pulling.
    b. By means of chemicals.

2. Studies in Ribes ecology, to secure information necessary to control methods and program.

3. Determination of effectiveness of control.

    a. As regards permanence of Ribes eradication.
    b. As regards protection of pine from infection.

"II. Line of Investigation. Determination of rate and direction of spread and intensity of infection of blister rust in District One, to serve as basis for rate of application of control program. Projects under way:

1. Annual scouting to determine rate and direction of spread of the rust.

2. Study of known infection centers, to determine rate and degree of intensification of the rust under conditions existing in the region concerned.

"All projects listed above are now under way, with the exception of I,3,b, which will be undertaken when infection reaches areas upon which local control has been practiced. While none of the projects are completed, the progress to date has permitted the following results:

1. The development of a general program of control basically suited to the region and sufficiently elastic to permit future adjustment to rate and direction of spread of the rust and to local variation in general conditions.

2. The development of local control practices which, while subject to further refinement, are now ready for immediate application in their present form.

"Investigations on the epidemiology of the causal organism of blister rust under weather conditions and upon hosts existing in the Far West are being conducted by the Office of Forest Pathology, Bureau of Plant Industry."

The Idaho Forest Experiment Station is co-operating with the Spokane Office of Blister Rust Control by conducting two research projects, one dealing with germination studies of Ribes seeds, and one devoted to forest management in relation to blister rust control. In the germination studies, about 1500 seeds of 5 species of Ribes have been treated by nine different methods. Temperatures above atmospheric normal have been found to be one factor apparently necessary for artificial germination. A progress report on the relation of forest management to rust control was published in the November, 1928, issue of the Journal of Forestry. Both of these projects are planned for indefinite continuance. Results of the University of Montana experiments in hastening germination of various seeds possibly also may contribute to a better understanding of the factors controlling Ribes germination.

Diseases (Rot-producing)

The presence of defective hemlock and white fir in western white pine stands constitutes one of the most serious silvicultural problems in the northern Rocky Mountain region. There is not sufficient information available concerning the causes, visible signs, and rate of spread of the heart rots in these two species. The best methods of determining the degree of infection and the proper measures to practice in logging so that future growth may be maintained in quantity and quality have not yet been agreed upon. In order to make progress on this problem, the Idaho Forest Experiment Station program lists a project in pathology largely financed by the Forest Service, to extend at least a two-year period, which should result in more efficient control of heart rot in hemlock and white fir.

Fire

The need was stressed at the 1929 Council meeting for more efficient effort in fire research. Although the fire problem is admittedly the most urgent forest problem in this region, only a very small proportion of the research funds is devoted to it. Mr. Flint

pointed out that all forest areas in this region are burning five times faster than the rate which is acceptable for adequate control, and that timber-sale areas are being burned so rapidly that a large volume of our expensive silvicultural work is being completely lost. The need is not for more projects, but for more work on the existant studies, which are recognized as the most promising.

At present the Office of Operation is conducting experiments along six lines, four devoted to presuppression problems: the determination of adequate fire control, the use of radio communication, rating fire hazard and liability, and aerial photographic mapping; and two devoted to methods of suppression by use of explosives for fire-trench construction, and the use of small tractors for the same purpose. These problems are of a type which can be most conveniently investigated by the administrative organization, with the possible exception of radio. In this case advantage is being taken of Mr. Beatty's exceptional ability in such work, and the project is receiving exceptional support and attention.

The Northern Rocky Mountain Station continued to confine its effort in fire research to the three lines of work that have been recognized as most important since 1922, when this research was started. The most extensive project is the relation of weather to forest inflammability, including studies of fire behavior and the fundamentals of combustion. Second in importance, on the basis of time required, but perhaps first in the production of usable results which have been put into practice, is the study of lightning storms as a cause of forest fires. Third, is the co-operative work with the Weather Bureau in producing and disseminating weather forecasts of maximum value in forest-fire control.

During the past year the routine measurements of weather conditions and resultant duff and wood-moisture contents were continued at seven stations in northern Idaho and western Montana. At five of these stations this work is handled by the local Forest officers and the current measurements are used continually as checks on opinions of prevailing fire danger. At the other two stations, Priest River Experiment Station and the Experiment Station Lookout, the primary purpose of this work is to improve the technique, consequently, it is handled as research by the Experiment Station. The results of the measurements at all seven stations are recognized, however, as research material, and will be analyzed at some future date when the opportunity exists. Likewise the daily measurements at the Experiment Station and its lookout are used as current criteria of prevailing fire danger by all of the rangers on both the Kaniksu and Pend Oreille Forests.

During the year a report entitled "Measuring Forest Fire Danger in Northern Idaho," which explains the methods and results evolved in the first three years of this work, was printed as Miscellaneous Publication No. 29. Copies are being distributed to all Forest officers in this region so that they may use the methods

of measurement whenever possible in the future. Subsequent work has not shown the need of changing any of the conclusions issued in this report, but the new and greater volume of data should be analyzed as soon as possible to check the original work and to amplify it wherever possible. It is especially desirable to attempt to integrate the effects of all or at least several of the weather elements into a single figure or measure of resultant inflammability. Such integration is largely dependent upon the availability of a larger volume of measurements than were used for the preliminary report. After 1929, the quantity of data should be sufficient for such a purpose.

This project also includes studies of the behavior of fire, and the fundamentals of combustion. During the year three sample plots were installed ahead of going fires, the fuel volumes, arrangements, and conditions accounted for, and the rate of spread of fire mapped at frequent intervals as it crossed the plot. Simultaneous measurements were also made of atmospheric temperature, humidity, and wind, in order to determine their effects on fire behavior. This work is believed to be well worth while and should be continued in order to obtain a more thorough and more accurate knowledge of all the factors that effect rate of spread, hence difficulty and cost of suppression.

Such work naturally leads toward the fundamental laws of combustion. There are, however, certain basic controls, such as the moisture content of fuels, which are already known to be important and which need research and experiment. The relations of moisture content to inflammability of duff have already been worked out, and checks over a period of three years indicate that these original determinations of six degrees of inflammability are generally satisfactory. No such relations have been evolved, however, for wood, and that is the field of effort in most immediate need of attention. A preliminary working plan has been written to guide such work, and about fifteen tests have been made to date. Efficient progress is impossible, however, without better equipment and more personnel. Until this assistance is available, no further work of this type is recommended.

Co-operative work with the Weather Bureau, for the improvement of weather forecasts, consisted during the past year merely of correspondence with Forest officers to obtain better reports from Forest Service stations, and conferences with Weather Bureau officials. The forecasts received during the past year were generally rated by Forest Supervisors as a distinct improvement over past years, and there is every reason to believe that this progress will continue. Plans for 1929 call for an inspection of all Forest Service weather stations by Chapin and Gisborne to test all instruments and to instruct the observers in better methods of measurement and report. Approximately fifteen anemometers and three or four hygro-thermographs, supplied by the Weather Bureau, also are to be installed at existant and new stations.

During the past year no work whatever was done either on the radio reception of weather reports and forecasts, or on the use of

the quadrant electrometer for measuring atmospheric electrical potential gradient. The latter possibility of new knowledge of electrical storms is recommended for additional effort when finances permit.

The Spokane office of the Weather Bureau, which handles the fire-weather work in this region, lists two projects which need a large amount of research work. The first of these has the objective of localizing relative-humidity forecasts. This is a virgin field of effort in that no humidity records were obtained from forested areas in the mountains until very recently, and humidity forecasts were never attempted until the need for them was shown by forest-fire investigations. The second project is the localization of thunderstorm forecasts so that action can be taken with more assurance by the forest-protective organizations. This also constitutes a rather new field of effort in this region, but the progress already made is considered very promising. The Spokane Office of the Weather Bureau is greatly handicapped in all this research because of the press of routine work and the lack of finances for this special effort. The Investigative Council was unanimously in favor of urging the importance of this fire-weather research and the need for enabling funds.

Very little research effort is being devoted to the study of fire damage in this region, except incidentally in the course of other work. During the past year a tabulation of mortality by species fifteen months after a forest fire gave the following losses in per cent of total number of trees of each species on a methods-of-reproduction permanent sample plot:

	%
Western larch	2
Douglas fir	19
Lowland white fir	45
Lodgepole pine	50
Western white pine	60
Western red cedar	73
Engelmann spruce	75
Western hemlock	78
Alpine fir	94

It is interesting to note that this rating checks without a single deviation, a theoretical order of susceptibility to fire damage published by Flint in 1925 in the Idaho Forester. Flint based his rating on thickness of bark, root habit, resin content of bark, branching habit, stand density, inflammability of foliage, and lichen growth.

Many of the permanent methods-of-reproduction plots can be expected to yield additional information of this kind on fire damage. Likewise, whenever permanent plots are established in the study of fire behavior, re-examinations are certain to give data on losses of all sized trees according to the fuel type, severity and time of burn, etc.

Insects

All of the entomological research conducted in this region is by the Coeur d'Alene Station of the Bureau of Entomology. Ten projects are listed as follows:

1. Parasites and predators of the mountain-pine beetle.
2. Insects and forest fires.
3. Defoliation of trees by forest insects.
4. Winter killing of yellow-pine foliage.
5. Bark beetle control.
6. Environmental factors influencing the destruction of bark beetle broods liberated by peeling.
7. Life history of Dendroctonus monticolae.
8. Maintenance control of endemic bark beetle infestations in white pine.
9. Artificial methods of bark beetle control.
10. Ecology of timber types following insect epidemics.

According to Mr. J. C. Evenden, in charge of this work:

"Several of these projects are not carried as major lines of activity and the time which is devoted to them is only secured before or after the regular field season, or at odd times during the summer. For the past few years we have been confronted with tremendous epidemics of the mountain pine beetle within the lodgepole pine stands of Montana and Idaho. Under the pressure of such an economic and spectacular situation, it was necessary to direct the entire efforts of the Station personnel toward the study of this problem. Such action was necessary for the purpose of developing a more advantageous and economical method of control for such outbreaks than those which are in use at this time. The problem has been attacked from many angles, and though progress has been made it has consisted, for the most part, in the elimination of what were thought to be promising leads at the time the study was instituted. This project will be continued until such time as satisfactory results are obtained, as the economic importance of the problem at this time and in the future will most assuredly warrant such action.

"This concentration of personnel upon the study of this one problem, which in the face of existing circumstances was and is an economic necessity, has resulted in a rather discouraging neglect of other projects which are equally as deserving of attention. Some of the most important problems of this District which at this time are in need of an adequate study are as follows:

(1) Study of the mountain pine beetle in its relation to the white pine stands of Idaho and Montana for the purpose of developing more efficient and economical methods of artificial control.

(2) Study of the spruce bud worm with the idea of developing some method of artificial control for the protection of timber stands and to determine the possibilities of preventing future depredations

through the adoption of some silvicultural practice.

(3) An adequate study of the interrelation of forest fires and insects. Such a study to cover the different tree species and both the primary and secondary insects attacking them.

(4) Interrelation of slash and subsequent insect depredations. This study to interpret the word slash in its broadest sense and to include logs left in the woods over a period of months; cull logs and chunks, windfalls, etc., as well as the usual debris following a logging operation. All classes of insects; bark beetles, wood borers, etc., to be included in such a study.

(5) The damage to logs and cedar poles by ambrosia beetles, horntails, and other wood boring insects.

(6) Douglas fir beetle and its control.

"Though these problems of forest entomology have been rather briefly outlined in their titles, many of them would need to be subdivided into several phases. All of them would call for an intensive fundamental study before any results can be expected, and at this time their institution in the investigative program of the Coeur d' Alene Station of the Bureau of Entomology becomes an impossibility with our present personnel."

Forest Products

Review of Progress and Results - 1928

In reviewing the progress made in Forest Products Investigations during the year 1928, the new classification of Major Lines of Forest Research has been followed as closely as possible. Wherever an agency other than the D-1 Products Office has carried on an investigation or study in Forest Products research, a brief summary of the progress made has been included in this review.

A. Lumbering.

1. Logging.

(a) Logging Output Bulletin - in D-1 Products Office, Forest Service.

During 1928 considerable progress was made in preparing a new manuscript for publication. A preliminary draft of the first section of the manuscript was reviewed by Mr. Clapp.

(b) Woods Utilization Study - D-1 Products Office, Forest Service.

Field work on this project was started during the early spring of 1928. One man was in the field on the inventory from April 1 until June 10 when a field assistant was employed who worked until September 1. From then until November 10 about 40 per cent of one man's time was spent in the field. Two months' time of one man was spent on office

compilation and analysis. Data on 439 fifth-acre plots, or 88 acres, were secured in the white pine type, which completes the wood-waste survey section of the study in this type. Data on 209 fifth-acre, or 42 acres, were taken in the western yellow pine type, and 25 fifth-acre plots in the lodgepole pine type.

(c) Chute Study - Forest School, University of Montana.

The object of the study is to determine the best slope or trough for hewing chutes. Nine different sized miniature logs cut to scale have been used thus far. Seven side slopes of trough ranging from 8 per cent to 44 per cent have been used. A total of 1500 measurements have been made. The work is being done by one student under personal supervision of his instructor.

2. Milling.

(a) Sawmill Studies - D-1 Products Office, Forest Service.

Field work and the office work of analysis and compilation on all except the depreciation study in fire-killed white pine was completed. Information and results obtained from the data collected by the 1925 mill-scale crew have all been published in the form of trade-journal articles. The final article, "Size and Defect - Important Factors in Lumbering," was published in four installments in the Timberman during the winter and spring of 1928.

A total of 6 man-months of clerical help was put in on the depreciation in fire-killed white pine study during 1928. The data are now ready for comparison and analysis.

(b) Lumber Transportation in the Mill Yard - Forest School, University of Montana.

This is a study of lumber transportation in the sawmill yard by wagons, bummers, and buggies with caterpillar traction versus horse traction. The study was conducted by a student under the direction of one of his instructors. Studies and timing of 200 trips of both teams and tractors were made and cost data figured. The field work was done in 1927 and the office work on the study was done in the winter of 1928. No field work was done in 1928. Results to date on the studies made show the cost per M of lumber hauled by the tractor to be 55 cents as compared to 38 cents by team.

(c) Tree-to-Mill Green-Chain Studies - D-1 Products Office, Forest Service.

These studies were initiated during 1928 to determine the costs of production and the value of the products produced from individual trees of different diameters and species. During the field season of 1928 a series of three studies was completed in the western yellow pine type of Montana. Data on from 125 to 175 M feet (log scale) of timber were obtained in each of the three studies. Two men from the Products Office spent twenty-five days each in the field on these studies. The

Office of Management contributed the time and expenses of a logging engineer for 25 days. The Kootenai Forest contributed the time and expenses of four Forest officers for a 10-day period on one of the studies. One month's time of one man was spent on office compilation on these studies during 1928. Some time was spent in making arrangements for the studies and in preparing forms.

B. Properties.

1 & 2 - Mechanical and Physical.

(a) Movement of Moisture in Wood - University of Idaho Forest School.

Studies are in progress of the influence of capillarity, gravity, and evaporation upon the rate and path of movement of added water and liquid stains through overdry heartwood and sapwood of western white pine.

(b) Electrical Measurement of Water in Wood - University of Montana Forest School.

The work has reached a state where preliminary laboratory experiments are complete and attention is being centered on the development of a commercial apparatus.

(c) Determination of the Fiber Saturation Point in Western Yellow Pine Wood - University of Montana Forest School.

A total of 337 one-inch cubes of clear western yellow pine wood were used in the work. These were tested for shrinkage and increased strength at all moisture contents from green condition to oven-dryness. The fiber saturation point was located at 31 per cent by the two methods used. The blocks have shrunk 0.8 per cent in volume and increased in compression strength 17.94 per cent at the saturation point as against the green condition. In overdry condition the total shrinkage amounted to 9.7 per cent, and in compression strength 281.18 per cent of the green condition.

(d) Measuring Some of the Effects of Repeated Swelling and Shrinking of Wood - University of Montana Forest School.

Tests are being made on western yellow pine and Douglas fir. Two hundred samples of each are being tested. The measurements so far indicate that wood continues to shrink and increase strength a little more with each cycle, but how far this will continue is not yet known.

(e) Study of the Cause and Control of Water Core in Western White Pine.

Field studies have been made on material collected from five different regions in northern Idaho. Preliminary studies have been made of the characteristics of this defect and of its distribution. Mill and laboratory studies have also been conducted on the moisture contents

common to the water core areas. A progress report has been issued.

3. - Wood Structure and Identification.

(a) The Diagnostic Characteristics of the Woods of the Genus Abies - University of Idaho Forest School.

About one and one-half years have already been spent on this project. About 300 permanent mounts of microscopic sections have been made and about 120 specimens of the various species have been examined. Data have been collected for each species and an early analysis points to the favorable solution of the problem.

C. Uses.

(a) Little-Used Species L-264 - D-1 Products Office, Forest Service.

Work on the western larch and white fir bulletins was confined in this District to the preparation of a report in memorandum form bringing together all the available data on the problem. These memorandums were completed in 1926. In 1928 an article based on the memorandum was published in The Timberman entitled "The Predicament of Western Larch."

The preparation of a manuscript on the utilization of lodgepole pine to be published as a departmental bulletin was initiated by the Products Office in 1927. Field work on this project is practically completed. Some time was spent on sorting out and analyzing the date collected.

(b) Utilization of Native Woods - University of Idaho Forest School.

Studies on better or new methods of utilizing woods and wood products native to Idaho, including a study of chemical derivatives of wood, slash, and other parts of the tree. Preliminary reports on the use of western red cedar for cigar-box stock and for poultry-house construction have been prepared. Tests on over 1,000 match stems of Idaho white pine to determine relative impact resisting strength of kiln-dried and air-dried stock have been completed. A report has been prepared. Preliminary tests are in progress to determine the yield of oils from the needles and twigs of slash material left on logging areas. Runs have been made and approximate yields determined on western red cedar, Douglas fir, and Idaho white pine.

D. Preservation.

(a) Durability of Woods in Service - D-1 Products Office.

Service Test Inspections - During 1928 eight of the service test projects were inspected and reports prepared. This was in accordance with the program outlined for 1928. Mr. Wirka of the Forest Products Laboratory accompanied Mr. Whitney on five of these inspections.

In addition to the regular service test inspections, details for the establishing of three new service test lines and experiments were worked out in conjunction with the Forest on which improvements were to be made. Mr. MacLean of the Laboratory, in company with Mr. Whitney, inspected the N. P. treating plant at Paradise, Montana, and several test tracks in the near vicinity.

(b) Studies of the Decay Resistance of Native Woods - University of Idaho Forest School.

Over 250 tests have been completed in the study of laboratory methods for determining decay resistance of native Idaho wood. In 1928 work on the toxicity of water soluble extractives and volatile compounds of western yellow pine was completed. New data on the moisture conditions favorable to the development of decay in wood have been obtained. Manuscripts are in preparation for publication.

(c) Studies of the Rots Found in Wood Products - University of Idaho Forest School.

Work is continuously being done on the isolation and study of fungi causing rot in wood products. Fungi have been isolated from window sash and garage door infected with brown rots. A study has been completed of the rots common in wooden portions of buildings and a report issued. This report will be published in January, 1929. No reports have been published as yet on the cause and control of decay in buildings.

(d) Studies on the Cause and Prevention of Sap Stain. University of Idaho Forest School.

A manuscript of 110 pages covering all available data on the cause and control of sap stain in lumber has been completed and is in process of publication by the National Committee on Wood Utilization. Field tests on the effectiveness of an end coating compound applied to ends of freshly cut logs were carried out in the summer of 1928. Laboratory studies have been completed on the effectiveness of some new organic mercuric compounds in preventing sap stain in lumber. To date over 340 laboratory tests have been made using different chemicals.

Publications - 1928

D-1 Office of Products, Forest Service

1. Trade-Journal Articles

a. Size and Defect - Important Factors in Lumbering -- by M. Bradner and S. V. Fullaway, Jr. Published in four installments in The Timberman. Final installment in the March, 1928, issue.

b. The Predicament of Western Larch - by I. V. Anderson. Published in the May, 1928, issue of West Coast Lumberman.

2. Miscellaneous

a. Production of Lumber and Other Timber Products in Montana and Idaho During 1927. A press notice by C. N. Whitney.

b. Custer National Forest Co-operates with Farmers in Preservative Treatment of Fence Posts - by C. N. Whitney. In 1928 Agricultural Year Book.

c. Monthly Trade Conditions.

2. Program of Investigations - 1929 (Continuing Projects)

Lumbering Studies

1. Logging.

(a) Logging Output Bulletin, D-1 Products Office, Forest Service.

It is planned to have the new manuscript completed early in 1929.

(b) Woods Utilization Study, D-1 Products Office, Forest Service.

The woods-waste survey part of the project will be completed in 1929. This will consist in the inventory in the western yellow pine, larch-fir and lodgepole pine types. Loss in gravity chuting studies will be done on the Kootenai and Coeur d'Alene Forests during 1929 field season. Breakage in felling studies will be done during the winter of 1929 for western yellow pine, larch, Douglas fir, and western white pine. Results of the woods-waste survey will be compiled and presented by April 1, 1930. Date of completion of specific studies indefinite.

(c) Chute Study - University of Montana Forest School.

A continuation of another two months of laboratory work by student and instructor and a compilation of the measurements. This is to be followed by a study of actual conditions in the woods.

2. Milling.

(a) Sawmill Studies, D-1 Products Office, Forest Service.

The completion and publication of a report covering the results obtained in the depreciation study in fire-killed white pine. Office work of compilation and analysis on the data obtained in the mill-scale studies completed in 1928 under heading of "Tree-to-Mill Green-Chain Studies." The preparation of reports covering results directly applicable to sawmill methods and efficiency.

(b) Lumber Transportation in the Mill Yard. University of Montana Forest School.

Further work may be done when tractor hauling is resumed at the mill in which the previous time studies were made. It is planned to make some

tractor output studies in the woods as well.

(c) Tree-to-Mill Green-Chain Studies, D-1 Office of Products, Forest Service.

Office work of compilation and analysis of data collected during 1928 on the three studies made in the western yellow pine type. Preparation and publication of results in trade-journal articles. Further studies of this kind in the Idaho white pine type and mixed-species types are contemplated but may not be conducted until the field season of 1930.

Properties

1 & 2 Mechanical and Physical.

(a) Movement of Moisture in Wood - University of Idaho Forest School.

The present studies will be continued, the influence of temperature will be investigated and similar studies will be made with western white pine wood of other moisture contents and with wood of other species.

(b) Electrical Measurement of Water in Wood - University of Montana Forest School.

Work will be centered on the development of a commercially practical apparatus.

(c) Determination of the Fiber Saturation Point in Western Yellow Pine, Douglas Fir, and Western Larch - University of Montana Forest School.

The study on western yellow pine is practically complete. Work will continue on one of the other species.

(d) Measuring Some of the Effects of Repeated Swelling and Shrinking of Wood - University of Idaho Forest School.

The laboratory work on Douglas fir and western yellow pine should be completed in February, 1929, and the compilation of results by March. It is planned to continue this project until all native Montana woods of commercial importance have been investigated.

(e) Study of Cause and Control of Water Core in Western White Pine - University of Idaho Forest School.

Work on this study will be continued as time and funds are available.

3. Chemical

(a) Wood Distillation - University of Montana Forest School.

This is a new project. The object is the distillation of Montana

sawmill run of waste wood for flotation oils and other products. The work is to be done in co-operation with the Montana School of Mines.

4. Wood Structure and Identification.

(a) The Diagnostic Characteristics of the Woods of the Genus Abies - University of Idaho Forest School.

After the examination and analysis of the sections already made, time will be spent on checking the characters from a large number of specimens as obtainable from all parts of the range of each species and variety. Micro-photographs and drawings are to be made of all important differences.

Uses

(a) Little-Used Species L-264, D-1 Products Office, Forest Service.

Completion of the final manuscripts by the Laboratory on larch and white fir. Preparation of trade-journal articles dealing with the utilization problems of these two species in this District after publication of the bulletins.

Some checking of markets and marketing conditions within the lodgepole producing centers of this region. Final check-up and analysis of data collected. Preparation of lodgepole pine manuscript.

(b) Utilization of Native Woods - University of Idaho Forest School.

Work on this project is to be continued. It is planned to complete the poultry-house study during 1929 and to carry out impact tests on blued and clear match stems. Additional tests on the extraction and uses of oils from slash will be made.

Preservation

(a) Durability of Woods in Service, D-1 Products Office, Forest Service.

Service-test inspections, as follows, will be made during 1929:

Project L-50 - Northern Pacific Test Track - Ties
Thompson Falls, Montana.
" " - Northern Pacific Test Track - Ties
Plains, Montana.
" L-214 - Montana Power Co., - Treated Cedar Poles
Harlowton to Billings, Montana.
" " - C.M. St. P. & P. Ry. - Electrified Pole
line, untreated cedar poles.
" " - Bison Range Fence - Cedar Posts
Moiose, Montana.

Project L-214 - Lower Gallatin District No. 2 - Lodgepole pine stubs. West Gallatin River District, Montana.

" " - Higgins Ave. Bridge - larch paving blocks, Missoula, Montana.

Some further work will also be necessary in completing the new service-test stub lines on the Gallatin, Absaroka, and Beaverhead Forests.

(b) Studies of the Decay Resistance of Native Woods - University of Idaho Forest School.

Mr. Sowder's and Mr. Anderson's manuscripts are to be prepared for publication. A manuscript giving the results of laboratory tests on methods is in preparation. Tests on all phases of the project will be continued through 1929.

(c) Studies of the Rots Found in Wood Products - University of Idaho Forest School.

The project will be carried on from year to year and new phases of the project will be studied as they appear. A more extensive survey of the prevalence of dry rot in buildings is needed. First bulletin on dry rot to be put out in January, 1929.

(d) Studies of the Cause and Prevention of Sap Stain - University of Idaho Forest School.

Work on various stages of this project will be continued. Studies on the effectiveness of new chemicals, relation of blue stain on the penetration and absorption of wood preservatives will be started during 1928 and 1929.

Publications - 1929

I-1 Office of Products, Forest Service

1. Departmental Bulletins

   a. Logging Output Studies.

2. Trade-Journal Articles

   a. Depreciation in Fire-Killed White Pine Timber.

   b. The Costs of Production and the Value of the Products Produced from Individual Western Yellow Pine Trees of Different Diameters.

   c. Footage Losses in Felling Inland Empire Timber.

3. Miscellaneous

   a. Newspaper Statement, 1928 Lumber Production of Idaho and Montana.

   b. Monthly Trade Condisions.

Grazing Investigations

Poker Jim Experimental Pasture

This project was turned over to the Custer Forest beginning with 1928. Owing to requirements of preference permittees, it was necessary to replace the breeding herd with a beef herd. Carrying capacity information was obtained from this class of cattle, also salt consumption, measure of the forage crop, and losses in the pasture. Owing to the scattering of the breeding herd over a large area after removal from the pasture, it was not possible to obtain a check on the 1928 calf crop which was the result of the 1927 pasture breeding. This information was very much desired and would have been of value in showing the further rate of increase in calf crop. However, the 1927 calf-crop results were sufficient to prove the value of pasture-breeding management on the range and, therefore, served the purpose for which this feature of the experiment was intended, although it did not indicate the maximum obtainable. The increase of 31.5 per cent from the second season of pasture breeding under range conditions was sufficient to demonstrate the value of the system to the stockman and the greater ease and effectiveness of control of the cattle to the Forest Service.

The information obtained during 1928 has not yet been compiled.

Plant Eradication - Larkspur (Delphinium)

This project was continued during 1928 on the Beaverhead. No work was done on the Madison. The results obtained during 1927 were only partially successful, the 66 per cent effectiveness obtained being confined entirely to young plants. It is not intended to conduct the injection method further, since it gives little promise of success.

The spraying method was used in 1928. Final results from this work will not be available until the spring of 1929. Sodium chlorate was used.

Plant Eradication - Goatweed (Hypericum perforatum)

This project was initiated in May, 1928. The spraying method of applying sodium chlorate was used and all plants treated were killed above ground. Shoots appearing from root crown after the tops had died succumbed before the growing season was over. Final examination in the spring of 1929 will show the result of the effectiveness of the chemical on the root system.

Crow Creek Experimental Pasture - Helena

The 1928 season was the first for this project. A herd of 84 cows and 3 bulls, ear-tagged for identification, were selected for stocking the pasture. Calf-crop information will be obtained from this herd. The same lines of study which are being carried in the Poker Jim Experimental Pasture on the Custer will be followed here excepting that of the need of salt on alkali ranges. No alkali is had on the

Crow Creek area or on the Forest ranges of this region with a few small exceptions.

Artificial Reseeding - Lewis and Clark

This project was initiated during 1928. Six plots ranging in size from 7 acres to ½ acre on representative sites were each planted with seed of four species of grasses and one species of sweet clover. A plot in a fenced check enclosure was seeded with each of these species for observation of their development under complete protection and for comparison with the other planted area.

Handling Stock - Gallatin

Sheep.

This project is co-operative between the Forest Service and the Montana Agricultural College. The band of sheep owned by the College is allotted range on the Bridger Division of the Gallatin Forest. This allotment was covered by grazing survey during 1928 and a management plan is in course of preparation. A co-operative agreement is in effect and the studies to be conducted will cover the principal phases of sheep management on the range with correlation with some phases of management while off the range.

The Seed Factor in the Management of Ranges

The determination of the effect of seed production, germination, and viability, is essential to the proper management of range lands in this region. To obtain information on these phases of the problem the Forest Service Office of Grazing collects seed samples which are tested in the laboratory by students under Dean Spaulding's supervision. In 1926 some 288 samples were tested, in 1927 there were 103, and in 1928 about 200 samples were submitted. This investigation is expected to continue at least four years more.

Carrying Capacity

Special studies to determine the forage-acre allowance on various ranges are being conducted on the Jefferson for cattle and on the Beartooth for sheep exclusive of the studies which are carried on in the experimental pastures on the Custer and Helena.

Seasonal Studies

No special studies to determine dates of vegetative readiness and the management of stock on the spring ranges were conducted during 1928, since all areas upon which grazing surveys are being conducted had been covered by seasonal study previously. No extension of this work was made because of shortage of funds.

Improved Methods of Handling Stock

This is being actively carried on on the Custer, Lewis and Clark, Helena, Beartooth, Jefferson, Selway, and Clearwater Forests.

New Projects

Possible co-operation with the B.A.I. at the U. S. Livestock Experimental Station at Miles City.

Ecology

Site Factors

No report has yet been published giving the results obtained by the Northern Rocky Mountain Station several years ago in a detailed study of three distinct sites at the Priest River Branch. As most of the original work was done by J. A. Larsen, now teaching forestry at Ames, Iowa, the preparation of a report has been turned over to him.

The University of Montana has one project employing permanent sample plots for the study of the effects of silvicultural practices and of various site conditions on rates of growth and yield of western yellow pine. As all of the field work is dependent upon class and individual student thesis work, progress is necessarily slow. Over a period of years, however, the volume of data collected will be appreciable.

Phenology

The past year witnessed the initiation of detailed phenological observations in each of the four principal timber types in this region. After a careful study of station locations, and the presence of interested and competent personnel, and the preparation of a detailed outline for conducting the work, instructions were issued for starting observations at 27 stations. The locations selected cover the western white pine, western yellow pine, larch fir, and lodgepole types very satisfactorily for a beginning. A preliminary review of the reports for the year has been made and a letter of comments to observers is to be prepared.

Forest Types and Succession

Some years ago considerable effort was devoted to the field study and collection of data concerning forest types in the northern Rocky Mountain region. As with the study of site factors, all of the original work was done by J. A. Larsen, and the preparation and publication of a report on forest types and their climatic controls in the northern Rockies is now in his hands.

The selection and permanent designation of natural areas, representing virgin forest conditions which shall remain unmolested in perpetuity, has received considerable attention in this region during the past year. One area of 128 acres in the overmature white pine type, and two in the hemlock cedar climax forest have been designated for this purpose on the Kaniksu National Forest, the white pine area being within the Priest River Experimental Forest. Nine or ten additional areas in various types are now in process of examination for this purpose.

The encroachment of western yellow pine reproduction on grasslands

in eastern Montana has long been one of ecological problems in the administration of range and timberlands in that region. A projected study on the Custer Forest, begun in 1923, has produced considerable information which is included in a progress report prepared by Hartwell in 1928. Due to Hartwell's absence on a year's furlough, very little work is planned for 1929.

The University of Montana has one project devoted to root competition and tolerance of western yellow pine which is expected to yield information on these factors and their effects on forest types and succession.

Species Studies

Larsen's "Conifers of the Northern Rocky Mountains" was submitted to Washington early in the winter.

Weidman is revising his manuscript "Timber Growing and Logging Practice in Western Yellow Pine of the Northwest" and plans to submit it in May.

Silvics and Dendrology

No research or investigation is under way in this region devoted either to silvics or dendrology.

Forest and Land Economics

A. Review of Progress & Results - 1928

(1) Annual Lumber Census - D-1 Products Office in Co-operation with D-4 and the Bureau of the Census.

The biennial canvass of all the producers of forest products in the States of Idaho and Montana was made and a preliminary press notice covering the 1927 production of lumber, lath, and shingles issued.

(2) Timber Survey of Private Lands - D-1 Products Office, Forest Service.

Fifth-year revision of the survey due winter of 1928-1929. Data from the field have been coming in currently. One man was detailed on this work of revision December 1, 1928. The timber type is being placed on all maps, where such information is available.

(3) Current Prices - D-1 Office of Products, Forest Service.

The following current projects were handled in the usual manner:

a. Lumber - mill
b. Lumber - retail
c. Stumpage
d. Log
e. Cedar Products
f. Ties - prices and specifications.

(4) Lumbering Costs - D-1 Office of Products, Forest Service.

a. Logging
b. Manufacturing

Average annual logging and manufacturing costs were obtained from 33 band mills. The detailed summary of these data was issued in the usual manner.

(5) A Forest Survey of Benewah County, Idaho, Including a Study of Restocking on Cut-over and Burned-over Lands - University of Idaho Forest School.

Upwards of 120,000 acres were surveyed during the summer of 1928. Some work on the compiling of field notes done. The survey indicates that a large percentage of the area is adequately stocked with fine young timber, largely western white and western yellow pine, and western red cedar.

(6) A Study of the Possibilities for an Adequate Taxation System on Forest Soils in Western Montana - University of Montana Forest School.

The preliminary collection of data was started during 1928.

(7) A Study of Co-operative Protection Agencies - University of Montana Forest School.

(8) Cost of Practicing Forestry in the Yellow Pine, Larch and Fir Types in Western Montana - University of Montana Forest School.

The area of no growth was roughly determined by means of maps from existing timber cruises from sketch maps and plane-table maps made in the field during summer of 1928. No work on compilation and analysis done during year.

B. Investigative Program - 1929 (Continuing and new projects.)

(1) Annual Lumber Census - D-1 Products Office, Forest Service.

This is an annual project. A canvass of all the mills in Idaho and Montana will be made and figures obtained on the production of lumber, lath, and shingles in the two States during 1928. Additional information on lumber distribution and stumpage values will be obtained this year. The canvass will be completed prior to July 1, 1929.

(2) Timber Survey of Private Lands - D-1 Products Office, Forest Service.

The first fifth-year revision will be made during the winter 1928-29. Two Forest officers will be detailed on this work and it is estimated that a total of five man-months will complete the revision. Data from the field will continue to come in currently.

(3) Current Prices - D-1 Products Office, Forest Service.

The following current price projects will be conducted during the year:

a. Lumber - mill
b. Lumber - retail
c. Stumpage.
d. Log
e. Cedar Products
f. Ties - prices and specifications

(4) Lumbering Costs - D-1 Products Office, Forest Service.

a. Logging
b. Manufacture

The average annual logging and manufacturing costs will be obtained by personal canvass of the band mills in the District. The information will be collected in March and a report made.

(5) A Forest Survey of Benewah County, Idaho - University of Idaho Forest School.

The survey will be completed in the summer of 1929.

(6) A Study of the Possibilities of an Adequate Taxation System on Forest Soils in Western Montana - University of Montana Forest School.

Compilation and analysis of data to arrive at a rough determination of the average absolute forest soils on nonused and cut-over lands and on marginal cultivated soils and the relationship between the tax and the stand, and tax and value.

(7) A Study of Co-operative Protective Agencies - University of Montana Forest School.

A more detailed inspection of Oregon, Washington, and California conditions by personal investigation of places and results is necessary.

(8) The Cost of Practicing Forestry in the Yellow Pine, Larch-Fir Types in Western Montana - University of Montana Forest School.

Intensive studies involving mil-acre plots will have to be made to determine the degree of stocking. Yield and rates of growth studies will also have to be made. Lack of funds will probably preclude any work on the project this field season.

Private Forestry Practice

Practically the only evidence of the practice of private forestry in the northern Rocky Mountain region consists of the voluntary organization

of timber-protective associations, State laws concerning forest protection, and slash disposal of different sorts according to the enforcement of State laws. Timber-protective associations, although primarily intended as a method of self-preservation and reduced fire-fighting costs, have, without any doubt, caused more forest land area to be green with forest growth to-day than would have been the case without such organization. The results have also been beneficial to the private owners by reducing the costs of fire control. Although these organizations were originally intended to protect only the merchantable timber, they soon found that it was necessary for such success to protect the cut-over lands as well. They also found that protection of these cut-over lands was desirable as an influence on public sentiment. The final result is that both classes of land are given full protection, with the most uniformity in Idaho where the State laws compel it, but with excellent success also in Montana.

Public sentiment favoring the practice of forestry has been slowly but steadily developed in this region. This is shown by the character of the forest laws passed by the legislatures of Idaho and Montana, and by the increasing ease with which favorable legislation is obtainable. Both States now have fairly satisfactory laws intended to control the method of slash disposal so that advance reproduction and the residual stands may have a better chance to provide a second timber crop from the land. An amendment to the Idaho law, just recently passed, enables the State Forester to suspend private logging operations if the company fails to dispose of its slash according to the law. The passage of such an amendment indicates the growing public sentiment in favor of forestry.

In both Idaho and Montana there are several cases of individuals or companies that strive to follow not only the letter of the law, but its spirit as well. One company, in Idaho, which admittedly does not intend to stay in the business is, nevertheless, leaving its cut-over lands in excellent condition insofar as slash disposal is concerned. Probably a majority of the private landowners, however, are indifferent or occasionally openly opposed to any forestry practice, especially if such practice tends to increase operating costs. Nevertheless an appreciable start has been made in the introduction of some desirable practices and with continued pressure, education, and demonstration there seems to be reason for expecting further progress.

The yield-tax law recently passed by the Idaho legislature is expected to serve very actively by encouraging more landowners to hold their young stands for later harvest. At least one wood-lot owner at present is known to be culling the poorer trees from his forest, so that the better stock may increase in quantity and quality more rapidly. It is also known that certain lumber companies in this region recently employed a consulting forester to prepare a working plan for their several hundred thousand acres of forest land. Such action indicates that some owners are at least investigating the possibilities of timber growing.

To assist all forest owners, and especially the small owners, in a better understanding of the potentialities of timber growth, the Northern

Rocky Mountain Forest Experiment Station has, during the last year, issued complete and detailed yield tables for white pine stands, and a brief form of tables for both western white pine and yellow pine. The District 1 Office of Forest Products is also contributing to this objective by a large amount of work to determine the costs of production and the value of the products produced from individual trees of different diameters and species. The private landowner must be shown not only the volume of wood that he can expect to grow in any definite period, but also the value. The Office of Products' investigation is expected to be completed for western yellow pine in 1929, and the work will then be transferred to other species as rapidly as possible.

Experimental Forests

Although experimental centers and branch stations are intended primarily to concentrate the field work of the Northern Rocky Mountain Experiment Station, they also serve as demonstration areas, not only for the people of the locality, but also for visiting foresters, private lumbermen, State officials, and officers of the Forest Service.

The Priest River Branch Station has for the past several years been used as a convenient location and demonstration area for senior classes of the Idaho School of Forestry, for Forest Service ranger training schools, and for guard camps. The visits of foresters, State officials, and interested lumbermen, are also becoming much more frequent. The demonstration possibilities of the experiments concentrated at that center have not as yet, however, reached their full value, nor have we as yet prepared the descriptive literature that will be essential to most interesting demonstration. A start has been made in the organization of available material, and it is hoped to complete within a year or two a short illustrated leaflet embodying the outstanding experiments, their purposes, and results. In the meantime, a brief mimeographed guide to the series of permanent experiments located at the Priest River Branch is to be prepared for the immediate use of visitors.

The intensive trail system designed for this 6,000-acre experimental forest is now practically complete. Plans also include some much needed maintenance work on the experimental firebreak. With these two projects completed, this forest unit will be one of the best protected areas in the northern Rocky Mountain region.

During the past year the area was photographed aerially by Mr. Flint, partly as an experiment and partly to provide the Station with a better working map of forest types and topography. The finished map measures about 3 by 5 feet, includes about 26 square miles, and serves to provide reference and information previously not available.

With regard to the ultimate number of experimental forests to represent the forest types in the region, the plan at present is to

have three for western white pine, one for lodgepole pine, one for western yellow pine, and one for larch-fir. Two of these are already existent. In the way of selecting the additional areas, four localities were visited during the past year. All trips were made by Weidman and Koch in company with the local Forest Supervisors or their representatives.

A proposed larch-fir area of nearly 7,000 acres examined on the Flathead Forest proved to be especially promising from the standpoint of accessibility, representative type conditions, young age classes, merchantable timber which is readily salable, etc. Two localities were investigated for a western yellow pine area. The area examined on the Bitterroot Forest contains 2,500 acres and is suitable in most respects, but lacks young age classes and is located in the region of the spotted-fever tick. The latter fact would naturally restrict its fullest use for field work previous to July 1 or 15 each year. The yellow pine region of the Thompson River drainage and Wolf Creek on the Cabinet and Blackfeet Forests failed to supply a suitable experimental area. National Forest land here is badly interspersed with private holdings, and desirable bodies of timber are too irregularly distributed to permit easy consolidation. Although the type conditions are exceedingly satisfactory in several places, the timber is not accessible and experimental cutting will not be possible for many years.

In keeping with the plan to select two additional white pine experimental areas for the central and southern parts of the type, respectively, one locality was examined on the Coeur d'Alene Forest. This area is on the upper part of Steamboat Creek and contains about 2,000 acres and 36 million feet of timber. The age class is almost entirely 100-120 years, and excellent merchantable timber, but virgin conditions and young age classes are far from being suitably represented. The area is not very accessible and is not as satisfactory in other respects as desired. It is believed that further search will discover a better area. On this trip the records in the Supervisor's office were gone over and several additional prospective areas found, which will be visited during the coming field season. At that time also it is planned to make a trip to a proposed area on the Clearwater Forest which has been in mind for several years.

As things stand at present, only the larch-fir area definitely meets the requirements and could be recommended. In view of this, it is believed that the report here given covers the situation and a formal report is not called for until the entire field can be covered, or at least until two of the three areas remaining to be selected can be found. In the case of the areas examined on the Bitterroot, Flathead, and Coeur d'Alene Forests, our project file contains detailed records of stand, type, age class, etc., contained in tables and on maps.

RELATIVE URGENCY OF EXPERIMENT STATION PROJECTS

The following statement shows the effort devoted to the various projects on the program for the fiscal year 1929, according to cost records to date and estimates for the remainder of the year.

Project	Cost by Per Cent of Allotment
Methods of Cutting	30
Experimental Forest	21
Fire and Weather	20
Methods of Reproduction	12
Public Requirements	10
Yield	4
Phenology	1
Miscellaneous	2
	100

The assignment of members of the staff to the above projects will be tentatively as follows for the present calendar year:

	In Charge	Assistance
Methods of Cutting		
Compilation of data	Haig	Clerical assist.
Re-examination of plots	Weidman	Haig, Gisborne, and field assistants.
Experimental Forests	Weidman	Thompson
Fire and Weather	Gisborne	Field assistant
Methods of Reproduction		
Re-examination of plots	Haig	Field assistants and Gisborne
Public Requirements and other Yellow Pine Reports	Weidman	
Yield		
Re-examination of plots	Haig	Field assistants
Phenology	Weidman	Haig
Thinning		
Re-examination of plots	Haig	Thompson, Weidman and Gisborne

ARTICLES AND PUBLICATIONS BY THE EXPERIMENT STATION

Submitted for Publication

1. Investigations in Chemical Weed Control at Savenac Nursery. W. G. Wahlenberg. Article. To J.A.R.

2. Modification of Western Yellow Pine Root Systems by Fertilization in in the Nursery. W. G. Wahlenberg. Article. To J.A.R.

3. Relation of Amount of Seed Sown and Density of Seedlings to the Development and Silviculture of Forest Planting Stock. W. G. Wahlenberg. Article. To J.A.R.

4. What is Research? R. H. Weidman. Article. To Northwest Science.

5. The Accuracy of Quadrat Sampling in the Study of Reproduction on Cut-over Areas. I. T. Haig. Article. To Northwest Science.

6. The Industrial Revolution and Forestry. H. T. Gisborne. Article. To Journal of Forestry.

7. Conifers of the Northern Rocky Mountains. J. A. Larsen. Department Circular.

Published in 1928

1. Forest Research Activities in the Northern Rocky Mountain Region. R. H. Weidman. Northwest Science, Vol. 2, No. 2, June, 1928.

2. Nonindigenous Western Yellow Pine Plantations in Northern Idaho. G. S. Kempff. Northwest Science, Vol. 2, No. 2, June, 1928.

3. Life Histories of Some Western White Pine Stands on the Kaniksu National Forest. Robert Marshall. Northwest Science, Vol. 2, No. 2, June, 1928.

4. The Girdled Pine Still Lives. Robert Marshall. American Forests and Forest Life. January, 1929.

5. Experiments with Classes of Stock Suitable for Forest Planting in the Northern Rocky Mountains. W. G. Wahlenberg. J.A.R., Vol. 36, No. 12, June, 1928.

6. Preliminary Report, Yield and Volume Tables for the Western White Pine Type in the Northern Rocky Mt. Region. I. T. Haig. Mimeographed.

7. Second-Growth Timber Worth Holding in the Northern Rocky Mt. Region. District 1 and the Northern Rocky Mt. Forest Experiment Station. Illustrated, unnumbered Department leaflet.

8. Measuring Forest Fire Danger in Northern Idaho. H. T. Gisborne. Miscellaneous Publication No. 29. October, 1928. Department Circular.

9. Brush Disposal. H. T. Gisborne. Timberman, Jan., 1929. Article.

In Preparation or Proposed for 1929

1. Timber Growing and Logging Practice in Western Yellow Pine in the Northwest. R. H. Weidman. Bulletin.

2. Results on Permanent Sample Plots in Western Yellow Pine Ten Years After Cutting. R. H. Weidman. Article for J.A.R.

3. A Silvicultural Study of Western Yellow Pine in the Northwest. R. H. Weidman. Bulletin.

4. Yield, Stand, and Volume Tables for the Western White Pine Type. Final report. I. T. Haig. Bulletin.

5. Possible Yields of Second-Growth Western White Pine. I. T. Haig. Article.

6. Recovery and Growth of Understory Hemlock Released by Cutting. I. T. Haig. Article.

7. Growth and Reproduction on Cut-Over Areas in the Western White Pine Type. I. T. Haig. Preliminary Report.

8. Atmospheric Indices of Forest Inflammability. H. T. Gisborne. Article.

9. A Five-Year Record of Lightning Storms and Forest Fires in the Northern Rockies. H. T. Gisborne. Article.

10. Where is the Forest Pyrologist? H. T. Gisborne. Article.

11. Reproduction Following Fire and Logging in Northern Idaho. Robert Marshall. Progress report.

12. Results of Thinning Experiments in the Western White Pine Type. Gerhard Kempff. Progress report.

EXPERIMENT STATION STAFF

R. H. Weidman	Director
H. T. Gisborne	Silviculturist
I. T. Haig	Asst. Silviculturist
J. B. Thompson	Forest Ranger
Margaret H. Troop	Clerk

EXPERIMENT STATION BUDGET F. Y. 1930

	SI	GED-1	GE-Imp.
Salaries (permanent staff)	14,980.00		
Expenses " "	1,600.00		
Sal. & Exp. field and office assistants	2,765.00		
Maintenance & Operation of 2 autos	300.00		
Equipment and Supplies	500.00		
Freight, Express and Hauling	102.00		
Maint. & Adm. Branch Station		349.00	623.00
Maint. Team of Horses		200.00	
	20,247.00	549.00	623.00

REPORT OF COMMITTEE ON ORGANIZATION AND FUNCTIONS

OF DISTRICT INVESTIGATIVE COMMITTEE

The Committee agreed upon the following points bearing on the organization and functions of the District Investigative Committee and its annual meeting.

1. There is need of an annual meeting, preferably in January, of the men most interested in forest research in the northern Rocky Mountain region. As the Forest Service is the principal agency engaged in such research, and as it is most affected by the results of research, this annual meeting should be called by the District Forester, and he should be the chairman.

2. This meeting is largely in the nature of a round table discussion of reports. It is more of a council than a committee, and in view of the changed conduct recommended hereafter, the name should be changed to District Investigative Council.

3. There are two main purposes for this annual Council meeting:

A. For the information of all interested and active agencies, concerning the purpose, scope, status, results, and costs of each of the projects under way or proposed by each agency.

B. So that on the basis of this knowledge, each agency, and the Council as a whole, can discuss and recommend the general character and distribution of research effort in the region. The recommendations by the Council should be addressed to the agencies concerned.

4. This Council meeting should be attended by the same men, or their representatives, as the 1927 District Investigative Committee meeting. In addition, the firm of Mason and Stevens, and the Western Forestry and Conservation Association should be invited to send a delegate. Each authorized attendant should be recognized as a member of that Council and entitled to vote on all questions acted on by ballot. This will result in a voting membership of about 30 men. It is understood that the votes of this Council shall be advisory only.

5. It is recommended that each participating agency, especially the Forest Service, have a small committee to be known as its Research Control Committee, whose function it shall be to take the responsibility for official action on the recommendations of the Investigative Council, and to frame its own program of research.

For the Forest Service, it is recommended that the Control Committee be composed of the following six men, or their authorized representatives:

District Forester
Director of Experiment Station
Chief of Management
Chief of Operation
Chief of Products
Chief of Grazing

6. The method of presentation of reports to the Investigative Council is recommended as follows:

A. On or before December 1 each year the District Forester should ask each participating agency to submit, by December 15, a specified number of copies of a memorandum listing the forest-research projects under way, their relative importance, outstanding results, and plans for continuance or discontinuance. Projects should be grouped according to the classification given below under "C." A sample memorandum should accompany the District Forester's request.

B. Upon request by the District Forester, each agency should also prepare the necessary number of copies of a "Status Sheet" for each of the projects. (The special committee composed of Weidman, Wyckoff, Spaulding, and Hubert, is to define the type of work that will be recognized as a project.) Such a sheet should show the project name, scope - which includes field of knowledge, type of inquiry, whether research, investigation, experiment, study, or file project, - status to date - comprising the volume of work done and how nearly completed, - planned work, probable date of completion and man to whom the project is assigned. The necessary number of copies of each status sheet should be furnished to the chairman of the Council for distribution to participating agencies on or about December 15 each year.

C. These status sheets will be assembled by major lines of work, such as Artificial Reforestation, Influences, Management, Mensuration, Protection, Products, Grazing, Ecology, Silvics, Dendrology, and Economics. Under each of these heads the assembly also will be according to the following subdivisions:

I. Artificial reforestation
   a. Nursery practice
   b. Sowing and planting
   c. Seed

II. Influences

III. Management
   a. Cutting
   b. Reproduction
   c. Brush disposal
   d. Thinnings
   e. Valuation

IV. Mensuration
   a. Form
   b. Growth
   c. Stand
   d. Volume
   e. Yield

V. Protection
   a. Animals
   b. Diseases
      1. Blister Rust
      2. Rot-producing diseases
      3. Other diseases
   c. Fire
      1. Prevention
      2. Detection
      3. Suppression
      4. Meteorological factors
      5. Combustion
      6. Damage
      7. General
   d. Insects
   e. Weather, gases, etc.

VI. Products
   a. Lumbering
      1. Logging
      2. Sawmilling
   b. Timber Physics
      1. Mechanical Properties
      2. Physical Properties
      3. Wood structure & identification.

VI. Products (Cont'd)
   c. Wood Chemistry
   d. Uses
   e. Seasoning
      1. Air
      2. Kiln
   f. Preservation
   g. Standards of grades, tests, specifications.

VII. Grazing
   a. Artificial Reseeding
   b. Carrying Capacity
   c. Forage Analysis
   d. Handling Stock
   e. Natural Revegetation
   f. Periods
   g. Plant Identification
   h. Poisonous Plants
   i. Protection
   j. Range Improvements
   k. Special projects

VIII. Ecology
   a. Site Factors
   b. Phenology
   c. Types and Succession
   d. Geographical Distribution
   e. Associate Vegetation
   f. Natural Areas

IX. Silvics
   By species

X. Dendrology

XI. Economics
   a. Forest Resources
   b. Taxation
   c. Insurance
   d. Policy
   e. Industrial Relations
   f. Markets

D. In Council session each agency shall read from its memorandum the general statement on a single line of work, until all agencies have covered this field of effort. References will be made to the status sheets only when desirable. Before passing on to the next line of work there should be a discussion of the importance and co-ordination of effort in the particular field under study.

E. By following a complete outline of major lines of forest research and their subdivisions, some subjects or possible projects will be called to the attention of the Council even though there are no status sheets for such work. This is very desirable so that with changing conditions no necessary or potentially valuable research will be overlooked. It seems that in the past there has been some neglect in considering the possibilities under Ecology, Dendrology, and Economics, for example.

7. On or before December 1 each year, each participating agency should be furnished with a complete outline of the major lines of research and their subdivisions, with the request that each project sheet submitted to the Council be identified accordingly.

8. With this list there should also be sent a sample of a status sheet and a sample memorandum to illustrate the form of preparation and the character of condensed information desired.

ELERS KOCH
Chief of Management

H. R. FLINT
District Forest Inspector

H. T. GISBORNE
Silviculturist

REPORT OF SUBCOMMITTEE TO DEFINE RESEARCH

This committee was instructed: (1) to define research terms and consider related matters; (2) to devise a system for collecting itemized cost figures of all research work being conducted by the forest agencies in the region.

Definite understanding of research and its related terms is needed in order that the District Investigative Committee may readily recognize whether an undertaking is really research or more properly an administrative inquiry. If the former, it belongs to the province of the Committee for consideration; if the latter, it should be left for action by Administration without loss of time in an irrelevant discussion.

The purpose of securing the annual cost figures is to have a better index of the effort actually being devoted to the various projects than can be gained from a general statement. It is felt that this will serve as a working basis for ascertainfng the relative adequacy of effort on the regional problems and for better co-ordination in meeting the needs of problems receiving insufficient attention. It is believed that the desired information can be secured on a form sent out each year at the time the annual District Investigative meeting is announced by the Chairman. The form here shown is suggested for this purpose. This should be sent in by the several agencies when they submit their project sheets to the Secretary, and the latter will assemble the records of all agencies in one table in advance of the meeting. To truly represent the effort expended on lines of work, contributed funds or contributed time expressed in terms of money value should be included.

Annual Cost of Lines of Research Work
(Name of Agency Making Report)

Line of Work	Expended 1929	Proposed 1930
Management		
Nursery, Planting & Seed Studies		
Methods of Cutting		
Natural Reproduction		
Thinning		
Volume, Growth & Yield		
Forest Types		
Tree Studies		
Other Studies		
Protection		
Blister Rust		
Rot-Producing Diseases		
Entomology		
Fire Protection		
Products		
Grazing		
Economics		
TOTAL AMOUNT		

Signed _____

Date _____

With regard to the use of research terms, the tendency of foresters and allied workers in this region has been to designate all forms of investigative effort as research, and to use indiscriminately such words as research, investigation, and experiment. The situation calls for an exact definition of terminology as possible, in order that we may think and act clearly in making proposals, formulating plans, and offering recommendations dealing with the problems of the region.

The quest for a satisfactory definition of research led the Committee into a good deal of reference reading. It is clear from the variety of definitions found that research terms have not yet attained exact meanings generally accepted by scientific workers. Most authorities, however, seem to recognize certain distinct types of scientific inquiry of which research, investigation, study, and experiment are examples. Such slight differences of meaning as were found appear to depend upon the particular field of research in which a writer happens to be engaged; a scientist in industrial research, for example, having a somewhat different conception of the terms than one in biological research. In view of the situation, the Committee does not hesitate to offer its own definitions for use in forest research in this region. In framing these definitions, it has adhered to the basic meanings of the words and has made use of the best interpretations and distinctions of the authorities consulted. The first draft of the Committee's report contained about five pages of quoted definitions and accompanying discussion which, for the sake of brevity, are not here included.

The first effort perhaps should be to define broadly administration as contrasted with research. Administration may be said to be the performance of work by established methods with the object of producing definite and foreknown results. Research, on the other hand, is organized inquiry with the aim of discovering something that is unknown and of determining its causes and effects.

(1) Research, in its specific sense, is protracted and thoroughly organized inquiry, carried out systematically by controlled methods, with the object of discovering new facts and determining their causes and effects. Its results are an extension of the field of human knowledge.

(2) Investigation is organized effort leading to a thorough understanding of the reasons and relations of things already known, as distinguished from research, which has for its aim the discovery of facts, truths, and relations not previously known.

(3) Study is the process of acquiring information on the quantity and character of known facts in order directly to draw conclusions or formulate methods. This is one of the lowest forms of scientific inquiry and is closely related to survey, census, and inventory. Immediate practical need is usually the reason for conducting a study.

(4) An experiment is a setting up of certain physical conditions, with one of the variables under control, and with the object of determining the results empirically, i.e., by experience. The purpose may be

to discover something new, or it may be merely for verification. The aim of many experiments, in fact, is to test out or to adapt the conclusions from former work to a new locality, new species, or a new set of conditions. The aim of many experiments also is to get a relatively quick result without resorting to the detail of thoroughly organized research or investigation. In many cases this meets with the immediate need of the problem and of practice. The procedure in an experiment may be refined, or it may be by the so-called trial-and-error method.

(5) A project is a definite, scientific undertaking with a restricted objective and a clearly defined purpose, scope, and plan of attack. It is essentially a fixing of objective and boundaries to guide the investigator in prosecuting a piece of research work efficiently and free from the danger of digression into side lines. For the research executive, the project serves as the most convenient unit in planning, financing, and supervising the various lines of work of a larger research program. There may be research and study projects, investigative and experimental projects. A project may be a small or a large undertaking. It may be carried out by one or several individuals. It may require a long or a short time for prosecution. With regard to smallness, a single test-tube experiment, for example, would hardly justify designation as a project. The same thing may be true of a single isolated sample plot in the forest.

Although each of the forms of scientific inquiry have qualities and objectives of their own, they all have certain methods in common. Research, for example, may employ the method of experiment to discover certain facts, merely as a step in the process of determining a set of principles.

It may be worth while in this connection to list the usual steps involved in a complete inquiry into a problem and to indicate which of these steps are employed by research, investigation, study, and experiment. The steps are: (1) Collection and classification of data; (2) Analysis and correlation; (3) Establishment of principles or relationship of facts; (4) Evolution of working methods. A fifth step providing for practical application of the methods might be suggested, but this would be clearly administration, and thus outside the field of scientific inquiry. Of the above steps, research employs 1, 2, and 3; investigation utilizes 2, 3, and 4, not ordinarily making use of 1 for the reason that existing facts are involved; study and experiment employ 1, 2, and 4.

A report attempting to define research would not be complete if it failed to say something about the rather general dual use of this much-abused word. Specifically research is the highest type of organized inquiry. In addition to its specific use, however, and apparently in lieu of a better term, scientists generally employ research in a generic sense to cover all forms of scientific inquiry. Thus we speak correctly of a man conducting an intensive piece of fundamental research. But we speak also of the research program of an agricultural experiment station, meaning in this case not only its

fundamental research projects, but also the great bulk of its work in the form of studies and experiments. Likewise, we refer to the work of certain institutions as comprising research, extension, and administration, and here again the research covers the lesser, as well as the higher forms of inquiry that may be employed. Not only is the word widely used in this way, its use seems to be at least tacitly sanctioned. Certainly there is need for a general term to cover the whole field of scientific inquiry and research appears to fit the need better than any other word. Thus, in our use of it, we must distinguish a dual meaning for the term research.

It is desired to point out again that the purpose of the definitions given in this report is to aid in clarifying presentation and discussion of research programs by the various agencies at the annual District Investigative Meeting. For the sake of correct usage of words, if for no other reason, it would be desirable for those participating in this meeting to know what properly to call the process they employ in conducting a project, to say nothing of the desirability of securing uniformity of language between the co-operating workers and agencies. In line with this it would seem desirable to designate the type of research on each project sheet submitted to the Committee, i.e., whether it is a fundamental research, an investigation, a study, or an experiment. This can best be done in the first instance by the person preparing the project sheet, with the understanding that inconsistencies may be ironed out later by the Secretary in conference with representatives of the agencies. The line of demarcation between types of research may often be difficult to draw. In these cases it will be better not to attempt carrying out the classification too literally. Nor should the attempt be to exclude consideration of types of inquiry which may seem to be even lower in scale than those discussed in this report. Such quests for data may be in the nature of a census, an inventory, or a collection of figures, such as logging costs. In this connection it is well to remember that the function of the District Investigative Committee is, first, to consider all the forestry problems of the region, and second, how and by whom they can best be studied. It is felt that it would not be wise to attempt, as some members of the District Investigative Committee have suggested, to specify what projects should be taken up in the meeting and what should not. From a preliminary statement of the problems and a knowledge of methods of attack as herein outlined, the Committee can readily decide which of the projects listed in the various programs fall in or outside of its jurisdiction.

March 20, 1929.

R. H. Weidman, Chairman

E. E. Hubert

T. C. Spaulding

S. N. Wyckoff